# INCLUDING A HASHED SERVICE IDENTIFIER IN A PAGING MESSAGE FOR A SERVICE GROUP CALL

The present invention relates to the provision of services to wireless subscriber stations through a communication network.

It is known to provide services in systems where wireless stations are constantly or periodically listening to the communication channels over which the service is delivered. Such operating mode results in a significant power consumption for the wireless stations, particularly detrimental to their autonomy if the actual transmission over the channels is sparse.

For some new services, it is planned to make an announcement of the start of a relevant transmission in order to inform the wireless stations of when the communication channels must be listened to. The announcement may be performed by paging a group of wireless stations. Such paging is a quite conventional mode of reaching idle stations, i.e. stations that have no active communication in progress with the network. It is detailed for instance, in the context of UMTS ("Universal Mobile Telecommunication System"), in section 8.1.2 of the technical specification TS 25.331, version 4.1.0, Release 4, "RRC Protocol Specification", published in June 2001 by the 3GPP ("3rd Generation Partnership Project").

However, if no indication of the service is incorporated in the paging message, all the paged wireless stations read the specified channels, while only very few of them may actually have a subscription with the service.

Moreover, it is not readily feasible to include in the paging message a unique identifier of the service. Such identifier can be a long binary code not suitable for transmission over a paging channel because the amount of information broadcast on a paging channel has to be minimized to limit the radio interference and to reduce the processing accomplished by the idle stations and hence their power consumption.

An object of the present invention is to overcome the above limitation by optimizing the delivery of broadcast or multicast types of services.

The invention proposes a method of providing a service to wireless stations through a telecommunication network as set out in claim 1.

Other aspects of the invention relate to telecommunication network equipment and to wireless stations as set out in claims 5 and 8 respectively.

The invention provides a paging announcement of a starting transmission pertaining to a service identified by means of a hash of a data string including a unique identifier of the service. Such hash has a reduced size compared to the initial data string. Its uniqueness is not guaranteed, but the use of a hash algorithm to generate it minimizes the risk of collision.

Anyway, the unique service identifier is usually transmitted over the broadcast channel or channels bearing the service, so that the wireless stations paged by means of the hashed identifier can check the unique service identifier afterwards, and stop receiving the information if it does not match the stored service identifier. Thus, even if collisions occur (with a probability which can be kept low if the hash code length is sufficient), their only consequence is to make some wireless stations momentarily listen to the channel bearing a service to which they have no subscription. Since the consequences of a collision are not very harmful, it is not necessary to provide a very long paging identifier for the sole purpose of avoiding collisions.

Other features and advantages of the present invention will become apparent in the following description of non-limiting exemplary embodiments, with reference to the appended drawings, in which:

- figure 1 is a block diagram of a system suitable for implementing the invention; and
- figure 2 is a diagram illustrating an example of data string structure usable in an embodiment of the invention.

Mobile wireless stations 1 communicate with a cellular telecommunication network 2, comprising a radio access network 3 and a core network 4 capable of transmitting data. Although the invention can take place in any system having such entities, it will be described hereinafter in a particular embodiment of a UMTS system, without restricting the scope of the disclosure.

In this context, the wireless stations 1 are called UE ("User Equipment"), the radio access network 3 of the UMTS network is called UTRAN ("Universal Terrestrial Radio Access Network") and the core network 4 comprises interconnected switches called SGSN 5 ("Serving GPRS Support Nodes", connected to the UTRAN), and GGSN ("Gateway GPRS Support Node"). The GGSN 6 is a gateway for interfacing the UMTS network with external data networks, e.g. an IP ("Internet Protocol") network 11.

Servers 8-10 are arranged for providing broadcast services to UEs 1 having corresponding subscriptions. The services rendered can be of various types. In the following, we will more particularly consider services of the family referred to as MBMS ("Multimedia Broadcast/Multicast Service"), which is currently developed and standardized by the 3GPP. A description of its architecture and functionalities can be found in the technical specification TS 23.246, v.0.4.0, "MBMS ; Architecture and Functional Description (Release 6)", published in February 2003 by the 3GPP. MBMS enables a subscriber UE to receive data through a UMTS network in particular after having been informed of the start of a broadcast/multicast transmission.

MBMS uses a specific core network unit called BM-SC 7 ("Broadcast/Multicast Service Centre"), which is responsible for service provisioning and delivery. The BM-SC is typically connected to a GGSN 6 as shown in figure 1.

The services using the MBMS mode of delivery can be rendered by servers 8-9 connected directly or via an external network 11 to the BM-SC 7. If a UE 1 has a subscription with a particular service of the MBMS type (e.g. broadcast of thematic information, like sport results, stock information, event notification, etc.), the corresponding server 8-9 is arranged to send data to the BM-SC 7, so that it is broadcast or multicast to the attention of the subscriber stations. The UE 1 is also able to receive the broadcast or multicast data, since it has a subscription with such service.

For this purpose, each time a transmission is about to be started for the service, which means data is going to be broadcast/multicast, the UMTS network 2 pages a group of UEs to cause them to switch to the relevant broadcast channel. As mentioned previously, paging is a classical functionality of radio telecommunication

networks. It consists of sending a message to a group of UEs depending on their location.

In the UMTS system, a feature called Discontinuous Reception (DRX) allows the creation of groups of UEs which only monitor one paging channel. Paging messages are transmitted for a paging group only at some paging occasions within a temporal DRX cycle. Accordingly, the UEs of that group only listen to the paging channel on these occasions. This mechanism is described in the technical specification TS 25.304, version 5.2.0, Release 5, "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode ", published by the 3GPP in December 2002.

Moreover, it can be noted that a paging indication mechanism has also been defined in the UMTS system to improve the DRX efficiency. It offers the possibility of having a number of subgroups within each group, determined by a specific coding transmitted over a paging indicator channel (PICH). A UE can thus only listen to the PICH corresponding to its subgroup, and then decode the corresponding messages if any.

According to the invention, the paging message used for reaching a group or a subgroup of UEs for which an MBMS transmission is intended is defined in relation with a subscribed service, so that (almost) only the UEs that have a subscription for the relevant service are paged to be warned of a MBMS transmission for the service. For this purpose, the identifier used for the paging group of the subscriber UEs incorporates data depending on the related service.

Each service is in principle identified in a unique way. Such identifier is stored in the UMTS network 2, which means it can be physically stored in a memory within the network or simply retrieved by the network (e.g. from the provider server) when necessary. It is also stored within the subscriber UEs, i.e. in the UE memory or in a subscriber module associated with the UE, on the condition the UE has a subscription with said service. Such storage in the UE can result from a previous provisioning step. Since the number of different services which can be offered through a multimedia network such as UMTS is potentially high, the unique identifier for each service is typically coded on a large binary sequence.

For instance, the unique service identifiers can advantageously comprise a combination of an IP address associated with the service (e.g. IP multicast address over which the service is multicast, IP address of the corresponding service provider server), or a corresponding uniform resource locator (URL), and an indication of the scope within which the above address is unique, for instance the APN ("Access Point Name") of the access point to which the server is connected, as commonly defined in particular in GPRS systems.

Such unique service identifiers can contain more than 200 octets. This long size is incompatible with the dimensioning of the paging channels, especially with the format of usual paging group identifiers (typically less than 20 bits).

According to the invention, the paging group identifier defined by the UMTS network in order to inform the subscribed UEs of the start of a transmission for an associated service includes a hash code obtained from the unique service identifier by using a hash function. Such hash code has a size significantly reduced compared to that of the original identifier. It thus can be well adapted to the paging capabilities.

The hash function is thus performed on a data string including at least part of a unique service identifier. In an advantageous embodiment of the invention, the data string to be hashed also includes an indication of the type of the corresponding service. Indeed, the service can have different types. For instance, services provided by the servers 8-9 are of the MBMS type. But for other services, like the ones offered by another server 10 (not connected to the BM-SC 7 in figure 1, but directly to the GGSN 6), another type can be used. A service platform can also be used between the GGSN 6 and the BM-SC 7.

Many hash functions are well known and can be used in the context of the invention. For instance, they can be based on common cryptographic hash algorithms, like MD2 (as described in RFC 1319, "The MD2 message-digest algorithm", published in April 1992 by the Internet Engineering Task Force (IETF)), SHA-1 (as described in the FIPS publication 180-1: "Secure hash standard", published in April 1994 by the National Institute of Standards and Technology), or MD5 (as described in RFC 1321, "The MD5 message-digest algorithm", Rivest, published in April 1992 by the IETF). All these hash algorithms guarantee a low

probability of collisions. In other words, the probability of obtaining an identical hash code from two different data strings is low.

In fact, the hash function used in the present context does not need to have the cryptographic properties of the above-mentioned algorithms. Alternatively, the hash function is based on cyclic codes conventionally used in error detection or correction schemes. For instance, a conventional cyclic redundancy checksum (CRC) is suitable as the hash code derived from the long service identifier, especially if a mechanism for checking a posteriori the value of the entire unique service identifier exists as will be described hereinafter.

An advantage of the CRC, or of other types of simple hash function, is that they are much less computationally intensive than the cryptographic hash functions. This is an important advantage for low-resource devices such as UMTS terminals.

The hash algorithm used for coding the unique service identifiers may consist of extracting the first n bits of the result of one of the above-mentioned hash algorithms applied to the data string including unique service identifier, where n is defined according to the typical size of paging group identifiers and to paging channel capabilities (e.g. n = 16).

The following C code illustrates an example of a simple hash function which can be used in the present invention to obtain a paging identifier ("hash") in the form of an integer variable from a service identifier ("*str") expressed as a character string:

```
unsigned int
hash(unsigned char *str)
{
    unsigned int hash = 5381;
    int c;
    while (c = *str++)
        hash = ((hash << 5) + hash) + c;  /* hash * 33 + c */
    return hash;
}
```

Such computation is performed both in the network 2 and in the subscriber UE to associate that UE with the paging identifier. In the context of UTRAN, the network 2 which performs such computation to associate the paging identifier with the service, is typically the radio network controller (RNC) which interfaces with the SGSN, controls a number of radio transceiver nodes and implements the RRC protocol and in particular the paging function.

Figure 2 illustrates a possible structure of the data string ("*str") submitted to the hash function to compute the paging identifier. In this example, the data string has a first octet designating the service type, with a specific value specified for MBMS services and 255 other values, possibly reserved. The following octets #2, ..., n (where n is a variable integer) contain the unique service identifier, for example as a concatenation of APN and IP multicast address.

Upon reception of a paging message for its paging group, a UE switches to the broadcast or notification channel over which data from server 8 or 9 is transmitted according to the announcement made on the paging channel. The identity of the broadcast channel can be indicated to the UE by signaling or it can be known in advance by the UE.

The unique service identifier is included in the header information transmitted on the MBMS broadcast channel. Therefore, a paged UE can compare the unique service identifier received on that channel with the one stored in its memory. If the two service identifier do not match, it can conclude that it is not concerned by the service, disregard the information received on the MBMS channel and return to the idle mode. If they match, the UE will proceed with receiving the information pertaining to the service over the broadcast channel.

This checking mechanism reduces the effects of collisions resulting from the hashing operation, with a probability 1/65536 if the paging identifiers are made of 16 bits.

As can be understood by the one skilled in the art, the invention can be used with radio telecommunication networks different from UMTS networks. It can also be used for different types of service.